No more ice in paradise: Ages of Pleistocene glaciations on Mauna Kea, Hawai'i

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Mauna Kea is the highest of five volcanoes that comprise the island of Hawai'i and is the only location in the interior tropical Pacific known to have been glaciated. Although glacial deposits have been mapped and investigated here for nearly a century, the timing of glaciations has proven difficult to resolve. We have developed a new chronology of glacial events on Mauna Kea using in-situ cosmogenic ^{36}Cl dating of boulders and glacially abraded bedrock, and ^{40}Ar/^{39}Ar dating of lava flows interstratified with glacial deposits. Using these chronometric systems in tandem, one of which dates the depositional event itself (cosmogenic ^{36}Cl) whereas the other yields bracketing ages for glaciations (^{40}Ar/^{39}Ar dating), provides compelling evidence of the antiquity of events.

^{36}Cl ages of samples collected during the 2000 field season from the two oldest glacial deposits, Pohakuloa and Waihu, exhibit bimodal distributions, which we interpret to represent the timing of deposition (older mode) and boulders that were subsequently exhumed (younger mode). The older modes are centered on 147±14 ka (2σ) for the Pohakuloa boulders and 110±12 ka for the Waihu boulders and abraded bedrock. ^{40}Ar/^{39}Ar ages place the Pohakuloa glaciation between 166±36 ka and 163±10 ka, and the Waihu glaciation between 122±30 and 97±29 ka, in agreement with the ^{36}Cl ages. In January 2003, we collected additional samples from the Waihu moraine for ^{36}Cl analysis and lava flows bracketing both the Pohakuloa and Waihu glacial deposits for ^{40}Ar/^{39}Ar dating to reduce the uncertainties associated with these landform ages. If the mean ages hold true, the similar terminal positions of the Pohakuloa and Waihu deposits on the volcano indicate that climatic conditions in the central Pacific during oxygen isotope stage (OIS) 5d were as conducive for ice cap formation on Mauna Kea as those that prevailed during OIS 6. The last deglaciation sequence began at 20.6±1.2 ka with deposition of the Makanaka moraine and terminated with the disappearance of the ice cap at 16.5±1.4 ka. The formation of a boulder-dominated fan at 13.2±1.5 ka suggests that significant high-elevation precipitation continued well after glacial ice had disappeared from the summit, consistent with a more southerly position of the North Pacific anticyclone during the late glacial.